Final Report

on

EFFECT OF SHOT BLASTING ON THE MECHANICAL PROPERTIES OF STEEL (NA-115):

PART I

by

R. L. MATTSON AND J. O. ALMEN

RESEARCH LABORATORIES DIVISION, GENERAL MOTORS CORPORATION

OSRD No. 3274
Serial No. M-228
Copy No. 225

February 19, 1944

This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U. S. C. 50; 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.
February 19, 1944

To: Dr. James B. Conant, Chairman
   National Defense Research Committee of the
   Office of Scientific Research and Development

From: War Metallurgy Division (Div. 18), NDRC

Subject: Final Report on "Effect of Shot Blasting on the Mechanical
         Properties of Steel (NA-115): Part I".

The attached final report submitted by J. O. Almen, Technical Representative on NDRC Research Project NRC-40, has been approved by representatives of the War Metallurgy Committee in charge of the work.

This report presents the results of experimental shot peening of machine parts and laboratory specimens to study the effect of shot peening on fatigue durability, impact, dimensions, ballistic limit of armor plate, and stress corrosion cracking.

I recommend acceptance of this report as a satisfactory final report on a phase of the work under Contract O.M. sr-1123 with the Research Laboratories Division of General Motors Corporation.

Respectfully submitted,

Clyde Williams, Chief
War Metallurgy Division, NDRC

Enclosure
PREFACE

This report is pertinent to the problems designated by the Office of the Coordinator of Research and Development, Navy Department, as NA-115, and to the project designated by the War Metallurgy Committee as NRC-40.

The distribution of this report is as follows:

Copies No. 1 thru 29 - Dr. Irvin Stewart, Executive Secretary, OSRD
Copy No. 30 - Clyde Williams, Chief, War Metallurgy Division (Div. 18), NDRC
and Chairman, War Metallurgy Committee
Copy No. 31 - Office of the Executive Secretary, War Metallurgy Committee
Copy No. 32 - V. H. Schnee, Chairman, Products Research Division,
War Metallurgy Committee
Copy No. 33 - R. C. Tolman, Chairman, Sub-Committee for Division 18, NDRC
Copy No. 34 - Roger Adams, Member, Sub-Committee for Division 18, NDRC
Copy No. 35 - W. F. Davidson, Staff Aide for Division 18, NDRC
Copies No. 36 thru 38 - War Department Liaison Officer with NDRC
Headquarters, Army Service Forces
Copy No. 39 - Commanding General, Watertown Arsenal
Attn: Director of Laboratories
Copies No. 40 thru 53 - Commanding General, AAF Materiel Command, Wright Field
Attn: Inspection Division, Materials & Processes Branch
Copies No. 54 and 55 - Commanding General, AAF Materiel Command, Wright Field
Attn: Captain J. P. Auerter, NDRC Branch Liaison Officer
Copy No. 56 - Army Air Forces Board, Orlando, Florida
Attn: Secretary of Board
Copy No. 57 - G. W. Lewis, Director of Aeronautical Research,
National Advisory Committee for Aeronautics
Copy No. 58 - F. E. Kyle, Research Supervisor, War Metallurgy Committee
Copy No. 59 - J. O. Almen, Technical Representative,
NDRC Research Project NRC-40
Copy No. 60 - R. L. Mattson, Investigator, NDRC Research Project NRC-40

Project Liaison Officers

Copy No. 61 - Office, Chief of Ordnance, Army Service Forces
Attn: Colonel S. B. Ritchie, Technical Division
Copy No. 62 - Commanding General, AAF Materiel Command, Wright Field
Attn: Major F. B. Fuller, Engineering Division
Copy No. 63 - Bureau of Aeronautics, Navy Department
Attn: N. E. Promisel
Copy No. 64 - Bureau of Ships, Navy Department
Attn: Harold Toner

Members of the Project Committee

Copy No. 65 - L. L. Wyman, Chairman
Copy No. 66 - A. L. Boegehold
Copy No. 67 - J. M. Lessells
Copy No. 68 - H. W. Russell
Copy No. 69 - F. P. Zimmerli

RESTRICTED
Members of the Engineering Committee,
Aircraft War Production Council, Inc.

Copy No. 70 - Boeing Aircraft Company, W. E. Beall
Copy No. 71 - Consolidated-Vultee Aircraft Corporation, Vultee Field Division, A. P. Fontaine
Copy No. 72 - Douglas Aircraft Company, Incorporated, A. E. Raymond
Copy No. 73 - Lockheed Aircraft Corporation, Factory A, Mac Short
Copy No. 74 - North American Aviation, Incorporated, Gordon Throne
Copy No. 75 - Northrop Aircraft, Incorporated, R. A. Dutton
Copy No. 76 - Ryan Aeronautical Corporation, B. T. Salmon, Chairman -

Members of the Plant Production Section,
Aircraft War Production Council, Inc.

Copy No. 77 - Boeing Aircraft Company, H. O. West
Copy No. 78 - Consolidated-Vultee Aircraft Corporation, San Diego Division, H. Bowling
Copy No. 79 - Lockheed Aircraft Corporation; Factory A, George H. Prudden
Copy No. 80 - North American Aviation, Incorporated; R. E. Dawe
Copy No. 81 - Northrop Aircraft, Incorporated, Paul Buckner
Copy No. 82 - Ryan Aeronautical Corporation, G. E. Barton

Members of the Testing and Research Panel
Aircraft War Production Council, Inc.

Copy No. 70 - Boeing Aircraft Company, W. E. Beall
Copy No. 83 - Consolidated-Vultee Aircraft Corporation, Vultee Field Division, Harold Boyvey
Copy No. 84 - Douglas Aircraft Company, Incorporated; J. R. Goldstein
Copy No. 85 - Lockheed Aircraft Corporation, Factory A, W. N. Wallace
Copy No. 86 - North American Aviation, Incorporated, L. F. Spalding
Copy No. 87 - Northrop Aircraft, Incorporated, T. E. Piper
Copy No. 88 - Ryan Aeronautical Corporation, J. C. Scurlock

Members of the SAE War Engineering Board

Copy No. 89 - The Autocar Company, B. B. Bachman
Copy No. 90 - Caterpillar Tractor Company, C. G. A. Rosen
Copy No. 91 - Chrysler Corporation, J. C. Zeder
Copy No. 92 - Ford Motor Company, R. H. McCarroll
Copy No. 93 - General Motors Corporation, Allison Division, C. R. Paton
Copy No. 94 - General Motors Corporation, Central Engineering Division, Louis Thomas
Copy No. 95 - General Motors Corporation, Chevrolet Motor Division, J. W. Crawford
Copy No. 96 - General Motors Corporation, Research Laboratories Division, D. R. Berlin
Copy No. 97 - Massey-Harris Company, L. S. Pfost
Copy No. 98 - Nash-Kelvinator Corporation, P. F. Kishline
Members of the SAE War Engineering Board (Con't.)

Copy No. 100 - Perfect Circle Company, R. R. Teeter
Copy No. 101 - Society of Automotive Engineers, Inc., R. C. Sackett
Copy No. 102 - Studebaker Corporation, R. E. Cole
Copy No. 103 - The Timken-Detroit Axle Company, L. R. Buckendale
Copy No. 104 - Willys-Overland Motors, Incorporated, D. G. Roos
Copy No. 105 - Wright Aeronautical Corporation, Arthur Hutt

Members of the Central Aircraft Council,
Engineering Policy Committee

Copy No. 106 - Bendix Aviation Corporation, Charles Marcus
Copy No. 107 - Chrysler Corporation, J. C. Zeder
Copy No. 107 - Ford Motor Company, William P. Pioch
Copy No. 95 - General Motors Corporation, Chevrolet Motor Division, J. M. Crawford
Copy No. 108 - Goodyear Aircraft Corporation, Karl Arnstein
Copy No. 109 - Parkard Motor Car Company, Colonel J. G. Vincent
Copy No. 110 - Pesco Products Company, Robert J. Minshall
Copy No. 111 - Republic Aviation Corporation, D. R. Smith
Copy No. 112 - Thompson Aircraft Products Company, A. T. Colwell
Copy No. 113 - United Aircraft Corporation, Frank W. Caldwell
Copy No. 105 - Wright Aeronautical Corporation, Arthur Hutt

Members of the War Metallurgy Committee

Copy No. 114 - Carl Breer
Copy No. 115 - Lyman J. Briggs
Copy No. 116 - James H. Critchett
Copy No. 117 - Col. R. S. A. Dougherty
Copy No. 118 - Rudolph Furrer
Copy No. 119 - H. W. Gillett
Copy No. 120 - S. D. Heron
Copy No. 121 - R. P. Heuer
Copy No. 122 - Zay Jeffries
Copy No. 123 - Col. G. F. Jenks
Copy No. 124 - J. B. Johnson
Copy No. 125 - John Johnston
Copy No. 126 - T. L. Joseph
Copy No. 127 - V. N. Krivobok

Copy No. 128 - Frédéric Leist
Copy No. 129 - W. K. Lewis
Copy No. 130 - Dean C. E. MacQuigg
Copy No. 131 - C. L. McCuen
Copy No. 132 - R. F. Mehl
Copy No. 133 - Paul D. Merica
Copy No. 134 - Col. S. B. Ritchie
Copy No. 135 - G. E. Seil
Copy No. 73 - Mac Short
Copy No. 136 - Capt. Lybrand Smith
Copy No. 137 - Col. A. E. White
Copy No. 138 - F. W. Willard
Copy No. 139 - R. S. Williams
Copy No. 39 - Col. H. H. Zornig

Aircooled Motors Corporation

Copy No. 140 - G. C. Servay, Syracuse 2, New York

Aircraft War Production Council

Copy No. 141 - James L. Straight, Los Angeles, California

RESTRICTED
Allied Aviation Corporation
Copy No. 142 - Ralph M. Tuttle, Chief Engineer, Baltimore, Maryland

Allis-Chalmers Mfg. Company
Copy No. 143 - J. T. Jarman, Milwaukee, Wisconsin

Aluminum Company of America

American Aviation Company
Copy No. 145 - Herbert De Cenzo, Chief Engineer, Jamestown, New York

American Foundry Equipment Company
Copy No. 146 - L. L. Andrus, Mishawaka, Indiana

American Locomotive Company
Copy No. 147 - T. R. Weber, Latrobe, Pennsylvania

Army Service Forces
Copy No. 148 - Office, Chief of Ordnance, Attn: J. D. Dunbar, Industrial Division
Copy No. 149 - Office, Chief of Ordnance, Attn: J. G. Jackson
Copy No. 150 - Commanding Officer, Springfield Armory, Attn: Lt. J. F. Libsch

Battelle Memorial Institute
Copy No. 151 - C. E. Sims, Research Supervisor, Columbus 1, Ohio
Copy No. 152 - C. B. Voldrich, Assistant Supervisor, Columbus 1, Ohio

Beech Aircraft Corporation
Copy No. 153 - Walter H. Beech, President, Wichita, Kansas
Copy No. 154 - T. A. Wills, Vice President and Chief Engineer, Wichita, Kansas

Bell Aircraft Corporation
Copy No. 155 - H. M. Poyer, Chief Engineer, Buffalo, New York
Copy No. 156 - R. J. Woods, Chief Design Engineer, Buffalo, New York

Bendix-Westinghouse Automotive Air Brake Company
Copy No. 157 - H. J. Williams, Elyria, Ohio

- Boeing Aircraft Company
Copy No. 158 - John K. Ball, Chief Design Engineer, Seattle, Washington

Brewster Aeronautical Corporation
Copy No. 159 - M. D. Moriarty, Long Island City, New York
Copy No. 160 - R. D. MacCart, Chief Engineer, Long Island City, New York

Brunswick-Balke-Collender Company
Copy No. 161 - J. A. Weagle, Chief Engineer, Muskegon, Michigan

Budd Manufacturing Company
Copy No. 162 - Michael Watter, Chief Engineer, Philadelphia, Pennsylvania
Cadillac Motor Car Company
Copy No. 163 - J. F. Gordon, Detroit 10, Michigan

Chrysler Corporation
Copy No. 164 - Tore Frazen, Detroit 3, Michigan

Columbus Aircraft Corporation
Copy No. 165 - W. Kenney, President & General Manager, Valley Stream, Long Island, New York

Consolidated-Vultee Aircraft Corporation
Copy No. 166 - James Kelley, San Diego Division, San Diego, California
Copy No. 167 - R. W. Liller, San Diego Division, San Diego, California
Copy No. 168 - L. F. Stoughton, Vultee Field Division, Vultee Field, California
Copy No. 169 - R. A. Schaus, Vultee Field Division, Vultee Field, California

Culver Aircraft Corporation
Copy No. 170 - A. W. Kooney, Vice President and Chief Designer, Wichita, Kansas

Curtiss-Wright Corporation
Copy No. 171 - R. C. Blaylock, Chief Engineer, Columbus, Ohio
Copy No. 172 - G. H. Cartledge, Acting Chief of Materials, Buffalo, New York
Copy No. 173 - C. C. Furnas, Director of Research, Buffalo, New York

Douglas Aircraft Company
Copy No. 174 - J. C. Buckwalter, Engineering Manager, Park Ridge, Illinois
Copy No. 175 - E. F. Burton, Chief Engineer, Santa Monica, California
Copy No. 176 - L. A. Carter, Engineering Manager, Oklahoma City, Oklahoma
Copy No. 177 - F. W. Conant, Vice President, Manufacturing, Santa Monica, Calif.
Copy No. 178 - D. E. Dunlap, Engineering Manager, Tulsa, Oklahoma
Copy No. 179 - Edward Harpootlian, Chief, Structures Section, Los Angeles, Calif.
Copy No. 180 - E. H. Heinemann, Chief Engineer, El Segundo, California
Copy No. 181 - F. W. Herman, Chief Engineer, Long Beach, California
Copy No. 182 - M. G. Simpson, Director of Quality, Santa Monica, California

Dow Chemical Company
Copy No. 183 - Dr. W. S. Loose, Midland, Michigan

 Eaton Manufacturing Company
Copy No. 184 - Hoy Clark, Detroit 13, Michigan

Excello Corporation
Copy No. 185 - R. K. Weldy, Detroit 6, Michigan

Fairchild Engine and Airplane Corporation
Copy No. 186 - Armand Thieblot, Chief Engineer, Hagerstown, Maryland

The Falk Corporation
Copy No. 187 - E. J. Wellauer, Milwaukee, Wisconsin
Firth Sterling Steel Company
Copy No. 188 - L. W. Weaver, Detroit 4, Michigan

Ford Motor Car Company
Copy No. 189 - F. C. Young, (Rouge Plant) Dearborn, Michigan

Fuller Manufacturing Company
Copy No. 190 - T. Backus, Kalamazoo, Michigan

General Electric Company
Copy No. 191 - T. S. Fuller, Research Laboratories, Schenectady 5, New York

General Motors Corporation
Copy No. 192 - C. W. McKinley, AC Spark Plug Division, Flint, Michigan
Copy No. 193 - J. R. Diver, Aeroproducts Division, Dayton, Ohio
Copy No. 194 - R. M. Hazen, Allison Division, Indianapolis, Indiana
Copy No. 195 - C. A. Chayne, Buick Motor Division, Flint, Michigan
Copy No. 196 - Harry Golden, Buick Motor Division, Melrose Park, Illinois
Copy No. 197 - R. E. Schenck, Buick Motor Division, Flint, Michigan
Copy No. 198 - E. H. Kelley, Chevrolet Motor Division, Buffalo, New York
Copy No. 199 - C. H. Frederick, Chevrolet-King Division, Kunkle, Indiana
Copy No. 200 - R. M. Critchfield, Delco-Remy Division, Anderson, Indiana
Copy No. 201 - F. G. Shoemaker, Detroit Diesel Engine Division, Detroit 23, Mich.
Copy No. 203 - Walter F. Burke, Eastern Aircraft Division, Linden, New Jersey
Copy No. 204 - R. M. Dilworth, Electro-Motive Division, LaGrange, Illinois
Copy No. 205 - H. A. Towner, Frigidaire Division, Dayton 1, Ohio
Copy No. 208 - T. C. Richards, G.C Laboratory Control Dept., Detroit 2, Michigan
Copy No. 210 - H. Youngren, Oldsmobile Division, Lansing, Michigan
Copy No. 211 - B. H. Anibal, Pontiac Motor Division, Pontiac, Michigan
Copy No. 213 - F. Rippingille, Research Laboratories Division, Detroit 2, Mich.
Copy No. 215 - T. C. Van Degrift, Research Laboratories Division, Detroit 2, Mich.
Copy No. 216 - H. Hawkins, Saginaw Steering Gear Division, Saginaw, Michigan

General Motors Proving Ground
Copy No. 217 - H. H. Barnes, Milford, Michigan

Gleason Works
Copy No. 218 - R. V. Adair, Rochester, New York

Goodyear Aircraft Corporation
Copy No. 219 - P. W. Litchfield, President, Akron, Ohio

Grumman Aircraft Engineering Corporation
Copy No. 220 - Leroy R. Grumman, President, Bethpage, Long Island, New York
Copy No. 221 - W. T. Schwendler, Chief Engineer, Bethpage, Long Island, New York
Howard Aircraft Corporation
Copy No. 222 - B. U. DeWese, President, Chicago, Illinois
Copy No. 223 - D. W. Dressel, Project Engineer, Chicago, Illinois

Inland Manufacturing Company
Copy No. 224 - F. W. Sampson, Dayton, Ohio

International Harvester Company

International Nickel Company
Copy No. 226 - T. H. Dickenden, Development and Research Division, New York, N. Y.

Interstate Aircraft and Engineering Corporation
Copy No. 227 - Don P. Smith, President, El Segundo, California
Copy No. 228 - W. A. Hite, Chief Engineer, El Segundo, California

Kaiser Cargo, Incorporated
Copy No. 229 - R. R. Wiese, Admin. Engineer, Fleetwings Division, Bristol, Pa.

Lockheed Aircraft Corporation (Factory A)
Copy No. 230 - O. E. Brown, Burbank, California

Lockheed Aircraft Corporation (Factory B)
Copy No. 231 - Robert E. Gross, President, Burbank, California
Copy No. 232 - H. L. Hibbard, Chief Engineer, Burbank, California
Copy No. 233 - J. McBrearty, Assistant Chief Structures Engineer, Burbank, Calif.
Copy No. 234 - F. R. Shanley, Chief Structures Engineer, Burbank, California
Copy No. 235 - F. A. Smith, Chief Design Engineer, Burbank, California

Glenn L. Martin, Company
Copy No. 236 - J. L. Bennett, Chief of Laboratories, Baltimore, Maryland
Copy No. 237 - Clifford E. Roberts, Assistant Chief Engineer, Baltimore, Maryland
Copy No. 238 - G. T. Willey, Vice President and General Manager, Omaha, Nebraska

McDonnell Aircraft Corporation
Copy No. 239 - J. S. McDonnell, President, St. Louis, Missouri
Copy No. 240 - E. W. Walker, Chief Engineer, St. Louis, Missouri

Nash-Kelvinator Company
Copy No. 241 - H. R. Costley, Aircraft Engine Division, Kenosha, Wisconsin

North American Aviation, Incorporated
Copy No. 242 - E. Schmued, in Charge of Development, Inglewood, California
Copy No. 243 - A. Wakesman, Materials Engineer, Dallas, Texas
Copy No. 244 - L. P. Spalding, Chief Research Engineer, Inglewood, California
Copy No. 245 - F. B. Bolte; Experimental Research Laboratory Mgr., Inglewood, Calif.
Northrop Aircraft, Incorporated
Copy No. 246 - J. K. Northrop, President and Chief of Design, Hawthorne, Calif.
Copy No. 247 - T. A. Feeney, Control Design Engineer, Hawthorne, California

Packard Motor Car Company
Copy No. 248 - W. H. Graves, Detroit 32, Michigan

Pangborn Corporation
Copy No. 249 - P. J. Potter, Hagerstown, Maryland

Pratt & Reed Company
Copy No. 250 - James A. Gould, Chief Engineer, Deepriver, Connecticut

Pratt & Whitney Aircraft
Copy No. 251 - W. A. Parkins, East Hartford, Connecticut

Ranger Aircraft Corporation
Copy No. 252 - M. Epps, Farmingdale, Long Island, New York

Republic Aviation Corporation
Copy No. 253 - R. W. Miller, Executive Engineer, Farmingdale, New York
Copy No. 254 - Alexander Kartveli, Chief Engineer, Farmingdale, New York

Ryan Aeronautical Corporation
Copy No. 255 - T. Claude Ryan, President, San Diego, California

The W. W. Sly Manufacturing Company
Copy No. 256 - R. W. Helmig, Cleveland, Ohio

Taylorcraft Aviation Corporation
Copy No. 257 - James C. Hart, President, Alliance, Ohio
Copy No. 258 - R. H. Wendt, Vice President of Engineering, Alliance, Ohio

Thompson Aircraft Products, Incorporated
Copy No. 259 - H. D. Bubb, Jr., Cleveland, Ohio

Timken Roller Bearing Company
Copy No. 260 - O. J. Horger, Canton, Ohio

Timm Aircraft Corporation
Copy No. 261 - O. W. Timm, President and Chief Engineer, Van Nuys, California
Copy No. 262 - George Michky, Chief Design Engineer, Van Nuys, California

Union Spring and Manufacturing Company
Copy No. 263 - K. Powell, New Kensington, Pennsylvania

United Aircraft Corporation
Copy No. 264 - S. Gluhareff, Sikorsky Aircraft Division, Bridgeport, Connecticut
United States Navy Department
Copy No. 265 - Director, David Taylor Model Basin, Navy Department, Washington, D.C.
Copy No. 266 - Mr. Stewart, Engineering Experiment Station, Annapolis, Maryland
Copy No. 267 - A. D. Wagner, Naval Ordnance Plant, Centerline, Michigan

Vought-Sikorsky Aircraft
Copy No. 268 - I. I. Sikorsky, Engineering Manager, East Hartford, Connecticut

Waco Aircraft Company
Copy No. 269 - C. J. Brukner, President, Troy, Ohio
Copy No. 270 - A. F. Arcier, Chief Engineer, Troy, Ohio

War Production Board
Copy No. 271 - Maurice Nelles, Chief, Industrial Processes Branch, OPRD

Wright Aeronautical Corporation
Copy No. 272 - A. V. Mathey, Paterson, New Jersey

Copy No. 273 -
Copy No. 274 -
Copy No. 275 -
Copy No. 276 -
Copy No. 277 -
Copy No. 278 -
Copy No. 279 -
Copy No. 280 -
Copy No. 281 -
Copy No. 282 -
Copy No. 283 -
Copy No. 284 -
Copy No. 285 -
Copy No. 286 -
Copy No. 287 -
Copy No. 288 -
Copy No. 289 -
Copy No. 290 -
Copy No. 291 -
Copy No. 292 -
Copy No. 293 -
Copy No. 294 -
Copy No. 295 -
Copy No. 296 -
Copy No. 297 -
Copy No. 298 -
Copy No. 299 -
Copy No. 300 -

Total number of copies - 300

RESTRICTED